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ABSTRACT

Eurostat, the Statistical Office of the European Communities, is already making use of the new possibilities offered by the multimedia revolution and has started research to allow further progress in this direction. This paper defines interactive multimedia as the achievement of a dynamic symbiosis between several means of expression (several representations of real or imaginary worlds). The paper draws lessons from Eurostat's operational achievements and explores different areas open to future research: multimedia, new information technologies, graphics and visualization, and image and signal processing. General guidelines for future development learned from Eurostat's first experiences include: automate production by structuring information; ensure independence from the physical medium; be flexible to satisfy users; be user-friendly to all users; take care of the user interface; avoid sticking to present technology because technology changes so fast; and put the focus on multimedia resources. The paper also discusses automating the production process, including the pros and cons of using SGML and HTML for document definition. In order to disseminate statistical data to as large and diversified a public as possible, it is important to make the most of the possibilities new information technologies offer to ensure easier, faster access to more relevant information, according to the knowledge, expectations, and needs of each individual. Future trends are also discussed. (Contains 14 references.) (SWC)

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# Making the Best of New Information Technologies at Eurostat

**By:**

**Christian Guittet**

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# Making the best of new information technologies at Eurostat

**Christian Guittet**
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***Abstract:*** *Keen to improve its statistical information service constantly by taking full advantage of the most appropriate and modern techniques available, Eurostat, the Statistical Office of the European Communities, is already making use of the new possibilities offered by the multimedia revolution and has started research to allow further progress in this direction.*
*After first defining interactive multimedia as the achievement of a dynamic symbiosis between several means of expression (i.e. several representations of real or imaginary worlds), this paper draws lessons from Eurostat's operational achievements and explores different areas open to future research: multimedia, new IT, computer graphics and visualisation.*

***Keywords:*** *statistics, electronic dissemination, SGML, multimedia, information highways, Internet, CD-ROM, computer graphics, image processing*

Twenty years of Online Information Conferences ... it's time to look back ... have times changed that much? 1976: computer games were the craze; 1996: computer games are still the craze — but crude ping-pong you could only play on big machines available in public places has now given way to interactive movies you can play at home.

Fifty years of computing ... 1946: ENIAC, the first computer ever, slowly performed its first operation; 1996: mainframe computers which churned out tons of paper covered in text written in capital letters belong firmly in the past, and having on the desk or at home a personal computer which speaks and displays photographs or films now surprises no one, least of all the young, who have long been familiar with such technologies through video games.

The global information society (Ref s 1,2) has become fashionable nowadays and, as we are constantly being told, information highways drive us into the age of multimedia. However, what exactly is that? Unfortunately, although everyone is talking about it, not everyone means the same thing. The 'experts' all give a different definition while the layman speaks of a threefold marriage between television, computer and telephone, with leisure, communication, education, reading, pictures, music etc. all in mind.

Is any attempt to define the concept bound to fail? The very formulation of a definition is open to criticism, as 50% of turnover in five years time will come from products which are yet to be invented while multimedia will disappear, becoming invisible, like today's electric engines.

Aware of these difficulties, I therefore propose for the purposes of this paper to define interactive multimedia as the achievement of a *dynamic symbiosis between several means of expression, i.e. concurrent representations of real or imaginary worlds.*

Symbiosis, in biological terms, indeed refers to a lasting, mutually beneficial association between two living organisms. This is what we are dealing with here. It is not a matter of simply juxtaposing text and numerical data, sound, photographs and film, charts and animation. Several or even all methods of expressing knowledge should be thoroughly combined so as to integrate them in a whole which is more than the simple sum of the parts.

Dynamism is essential as well. The qualification 'interactive', often only implied but in fact inseparable, reflects the dynamic nature of a multimedia product. It is not fixed and unchangeable. Each reader recreates it each day, according to his or her own individual needs and personality, freed by such flexibility from any constraint on how to use it and gain access to knowledge.

## The lessons of experience

Quite a number of people think more of multimedia in terms of technology than in terms of applications. This is the wrong approach, however: what really matters is information. The key feature of information technologies is that cutting-edge products of today will be available off-the-shelf as soon as tomorrow, while creating content may prove extremely expensive and time-consuming.

This gives Eurostat — the Statistical Office of the European Communities — and more generally National Statistical Institutes much potential to be major players in the global information society. Indeed, as a result of statistical culture, a huge asset of primary data is available in a structured, digital form. The value of these data

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is confirmed by the existence of a large base of customers willing to pay to gain access to it.

To fulfil its mission, which is to provide the European Union with a high-quality statistical information service, Eurostat is therefore willing to take full advantage of the most appropriate and modern techniques available. It has already implemented the new possibilities offered by the multimedia revolution in a whole range of products: CD-ROMs, online services, information kiosks ... ; it has also started research to allow further progress.

**Figure 1:** Eurostat Information Kiosk at an exhibition.

For instance, the European Commission's Internet server, Europa, counted nearly 2 million contacts in July 1996, which make it one of the most successful political sites; with 100,000 hits, the Eurostat pages were amongst the most consulted, which clearly confirms the value of the first developments.

## Technical solutions adopted

Monolithic developments are definitely out-of-date. To produce this range of applications, the decision was taken to adopt a modular, flexible and open-ended approach, allowing services to be easily upgraded and external partners (National Statistical Institutes, database servers and so on) to add specific information.

More specifically, a combination of different software packages and file formats has been used, as most appropriate:

- Asymetrix Multimedia Toolbook has first been selected as a convenient tool to test different concepts and as an integrator from which other applications can be launched, whenever necessary;
- however, in consideration of the extremely rapid progress of Internet technology and of the flexibility offered by browsers plug-ins, the HTML format now forms the core of these electronic products: Web pages can be distributed not only on the Internet but also on all other appropriate media: diskettes, CD-ROMs, information kiosks;
- Adobe Acrobat has been selected to publish easily and without delay publications for which layout is important or complex, for example press releases (some of which include large tables) or sample pages of publications (even the full publications, for those which are free of charge);
- any presentation package or demo, starting with Java and Macromedia Shockwave applications, can potentially be used similarly to demonstrate electronic products;
- any Internet browser (depending on the user's preference) can be used in conjunction with appropriate plug-ins to view these pages; their design is indeed based on the HTML 3 specifications while extensions such as those proposed by Netscape Navigator or Microsoft Explorer are used whenever appropriate, in a way that does not make pages incompatible with other browsers;
- regarding bitmaps, JPEG files (*.JPG) are preferred to *.GIF files, because they generally allow for higher compression ratios while preserving RGB-true colours; however, exceptions to this rule are accepted for those images which are better compressed in the *.GIF format, as is the case for simple geometric drawings such as some charts, maps or book covers ... or whenever simple animation is needed; the progress of emerging, alternative compression techniques is also carefully monitored;


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- regarding sound recordings, the Wave format is being used at present but the intention is to include real-time audio, using technologies such as RealAudio;
- regarding video, tests have been conducted with different alternative formats to take into account the multiplicity of hardware: Microsoft Video for Windows is presently used, in conjunction with the Intel Indeo compression codec; as an alternative, the MPEG standard will be considered when playback facilities become in general use, while emerging technologies (such as Microsoft ActiveMovie or Iterated Systems Coolfusion) seem promising for real-time video.

## General guidelines

We have already been able to deduce from these first achievements some general guidelines that we will take into account for any future development:

- *Automate production by structuring information*. This is the only procedure likely to ensure not only the quality of information but also its timeliness and the monitoring over time. Like any other type of publication, multimedia publications have to be updated automatically from reference bases in which the logical structure of the information is identified, using techniques such as SGML. The ability to reuse general texts, illustrations, bibliographies (including the digitised pictures of covers or inside pages) and statistical data is then a real advantage. However, great care must be taken to ensure compatibility with the present situation, however unorganised it is: fortunately, electronic versions of older publications can easily be produced using software tools such as Adobe Acrobat.
- *Ensure independence from the physical medium*. The basic philosophy must be identical whatever the medium (CD-ROM, Internet ... even paper) subject to the limitations imposed by its technical nature. The concept of interactive multimedia transcends the notion of the physical medium with the result that the objective can (indeed must) be to produce similar publications in various forms, with a strong corporate image; one must however acknowledge that the wording itself of articles and texts has to be tailored in places according to the very characteristics of the medium: for instance, hyperlinks clearly have to be considered differently, whether they appear in a printed book or an electronic publication.
- *Be flexible to satisfy users*. Only the best is good enough. But not everybody agrees on what is best, and specific technical limitations make the situation even worse. All the information on offer must therefore be presented systematically in the most appropriate formats, taking account of both production and dissemination aspects; as far as possible, the reader must be presented with alternatives, according to the actual availability of viewers on the various systems used. Using international (*de jure*) or industry (*de facto*) standards should always be considered, if only to benefit from the past experience implied by their making. Off-the-shelf products should also be favoured for the same reasons.
- *Be user-friendly to all users*. And 'all users' really means 'all users': the nerd or computer freak who runs all the latest beta-releases of all Internet browsers in turn and has downloaded all plug-ins; as well as the odd one who hardly knows how to turn his PC on and does not have the slightest idea of which applications have been installed — in fact, he doesn't even care as long as everything works. The system should also not take any unsolicited initiative but be designed to guide the user in need step by step to the 'right' solution.
- *Take care of the user interface*. The quality of the user-interface is of prime importance: it should of course be consistent and designed according to state-of-the-art ideas and best practices, making the service easy to use (ideally, no user-support should be necessary: there is no way to offer a personalised service to thousands of Internet users). But it should also incorporate some nice ideas that will make it attractive; for instance, in Eurostat's catalogue, a click on a cover gives access to the contents, in full in the case of free publications or in part. Examining successful products (Internet sites, CD-ROMs ...), whatever their subject, is always a rewarding experience, although copyright should never be infringed.
- *Avoid sticking to present technology*. The extreme speed of technological progress in this area means that a pragmatic, modular approach has to be adopted to simplify any future development in relation to changes in the environment. Technical choices have to be determined according to considerations such as:
  - the absence of clear, lasting solutions, which can be overcome by the observation of general trends on the market and the gradual emergence of standards;
  - the need to monitor closely the very rapid development of information technology;
  - the heterogeneity of hardware and software in general use, given the need to produce a product capable of very wide dissemination;
  - the cost of dissemination, given the need to pay for licenses for each copy distributed in the case of certain types of software;
  - the need to make rapid progress to avoid diluting the efforts made and the possibility of drawing on past experiences.
- *Put the focus on multimedia resources*. One picture is worth a thousand words. Multimedia resources as

such (music and sound recordings, still and moving pictures ...) are also needed in quantity, although their use must take technical constraints such as the limited bandwidth of networks into account. Several possible sources exist concurrently:

- royalty-free 'libraries' are a good start as they are the easiest to access but they have the disadvantages of being primarily American in origin and therefore culturally biased (for European users at least), frequently used (which may give the impression of *déjà vu*) and not being specific to the message to be put across;
- the use of resources available in the organisation entails selection, followed by processing, but has the advantage of involving other services in the product which will help dissemination; also, prices of appropriate equipment (scanners and video capture cards) and service bureaux (Kodak Photo-CD) are coming steadily down, making such an alternative more affordable;
- more specific illustrations, such as covers and sample pages of publications, interviews, statistical maps and so on add the final, corporate touch to a product.

## The key to success: automating the production process

SGML (Ref 3), the ISO standard to mark-up text, has been around for more than 10 years now and I still recall the great expectations that some placed on it when it was introduced: it would finally make publishing fast, cost-effective and easy.

The Office for Official Publications of the European Communities has been a forerunner in Europe, placing SGML at the core of its electronic publication system with FORMEX (Ref 4) as early as 1983 (at that time, SGML was not yet an ISO draft proposal). Eurostat followed the same tracks a little later and developed its STRINGS system. This SGML-like approach to automating the production of statistical documents is presently being upgraded to offer more advanced facilities and to take multimedia publications into account; the new release will be fully SGML-compliant.

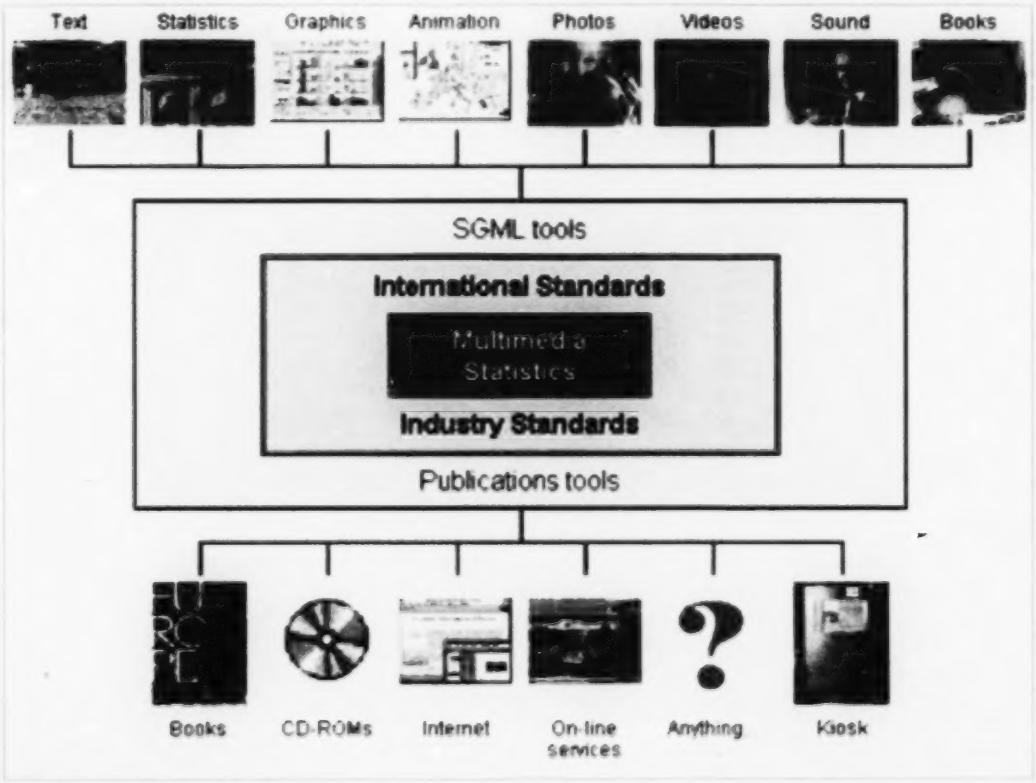


**Figure 2:** Multimedia statistics.



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All over the world, interest in SGML is increasing steadily but slowly, so that the rumour may be true that this acronym really stood for *Sounds Good, Maybe Later*. Indeed, I still know quite a few people (whose name I won't disclose here) who are not only unconvinced but even refuse to hear this four-letter word. They are afraid and still believe SGML is complicated, with all these markers and declarations — it is pretty unfortunate that possibilities to hide all the codes (using advanced features such as *OMITTAG* or *DATATAG*) have not been better advertised and that real SGML editors are not more widely available.

But things may change rapidly now, as these people have discovered a new magic keyword: not *abracadabra* — electronic publishing is not a fairy tale - but *Internet*: they are quite sure that the Web will make everything simple, as if by magic, and are volunteering to become the gurus of HTML ... while SGML-like editors are finally becoming popular.

However, a number of issues are still open and they should not concern Eurostat only.

### Is SGML still needed?

Starting to use SGML generally implies a lot of effort to modify the production process radically. If your intention is only to produce one-off paper publications, such an investment is probably not worth it. If you want to enhance these publications by also distributing their electronic copy, using SGML is probably still not worth it; it might even be a disadvantage, as SGML does not record the layout of a document: although the electronic version will be identical in content it will not resemble the paper original.

In such a situation, a better and easier solution is certainly provided by tools like Adobe Acrobat, which in an hour or so will turn any publication, produced on any system, into its electronic 'photocopy', while preserving access to the textual information itself (copy and paste, search and so on) and even allowing for enhancements (hyperlinks ...).

However, if you want to distribute a lot of information in different forms, targeting different users and making the best of all the facilities provided by the different technologies, you should probably start by structuring your information and storing it in a database; you would then be able easily to generate files marked-up as appropriate and use stylesheets actually to produce a whole range of publications in an automated way. In such a case, SGML is certainly a worthwhile approach, well worth being considered.

### Is HTML a valid SGML application?

Unfortunately not! For the time being, at least! The key characteristic of SGML, which gives it value, is that layout information is never embedded in a document: what really matters is its logical structure only, while formatting is defined in associated stylesheets, one for each medium.

This is unfortunately not the case with HTML: markers such as <ITALIC> or <BOLD> are obviously inappropriate and should be replaced with <EM> (emphasis, typically rendered as italic — but not necessarily) or <STRONG> (strong emphasis, possibly rendered as bold) which are also recognised by HTML browsers; but tags such as <CENTER> or attributes such as <P ALIGN = Justify> have no acceptable equivalent; also, it is quite unfortunate that using attributes such as <IMG width = 620 height = 465 align = center ...> should be recommended for practical reasons when writing pages for the Internet. Introducing stylesheets is urgently needed to improve the situation (and the news is good).

### How should *you* define *your* documents?

The DTD (Document Type Definition) is a key feature of SGML, used to describe the logical structure of the information. But this structure can only be defined in relation to the needs that must be met. For instance, suppose you want to publish statistics on unemployment. If all you have in mind is a table showing short-term and long-term unemployment, by sex and age-class, with one row per country or world region, you will probably consider a declaration defining a table (<TABLE>) as the combination of a caption (<CAPTION>), rows (<TR>) and cells containing a header (<TH>) or data (<TD>); this is the HTML approach and it will probably work fine. As long as you do not need to know what information is precisely contained in the cells, that is.

Indeed, in doing so you loose all semantic information related to the significance of the figures and any hope of processing this data: no calculation is possible, nor any charting of data. Your customers will not be able to take advantage easily of the facilities now offered by interactive multimedia.

## The way ahead

In order to disseminate statistical data to as large and diversified a public as possible, it is important to make the most of the possibilities new information technologies offer to ensure easier, faster access to more relevant information, according to the knowledge, expectations and needs of each individual.

Many people are in fact likely to use or be interested in statistical data. However many of them, particularly the non-specialists, may be put off as much by the difficulties of access to relevant, up-to-date information as by the daunting appearance of tables of printed figures, just as the opposite is true, as the success of Eurostat's flagship publications shows (*Facts through Figures*, *Europe in Figures*, *Portrait of the Regions*, etc.). It is however possible to make information a lot easier to find and retrieve by allowing the user to explore and understand what is available and helping him to formulate his requests, and a lot easier to comprehend by presenting results adequately.

Also, it is generally recognised that the key to progress is to establish links between (apparently) unrelated application domains and technologies — or, to be more provocative, between virtual user-needs and virtual technologies. The development of technology demonstrators can help potential users to identify the fulfilment of their needs as being within reach; the formulation of new needs as a reaction to these prototypes can in return stimulate future progress.

## Technology, an answer to user problems

Technology has no value in itself: it is only a tool to respond better to user needs. It is therefore essential to identify specific needs and to relate them to possible solutions; here are just a few examples:

- marketing teams are typically anxious to know their customers better; posting a registration form on the Internet is pretty straight-forward but you then have to rely on customers to fill it in; some incentive might be useful but candid users may simply be unable to answer technical questions — e.g. questions about the specifications of the system used (which processor? how much RAM? which screen? which sound card? what about the CD-ROM? the Internet connection? the browser and its plug-ins? ...); could an ActiveX or Java applet find that out automatically and return the information together with the registration form (subject to user agreement, of course)?
- edutainment is a big success nowadays and its value in increasing general culture is generally recognised; attractive statistical applications can be imagined and programmed for the Internet, using multimedia authoring tools like Shockwave; what about:
    - a quiz where the player would be presented with a blind chart (for instance, the GNP per capita) and be asked to add names of countries as appropriate?
    - a quiz where the player would be asked to fill 'tubes' with a coloured 'liquid' to represent what he believes to be the correct data for different countries?
    - a game where the player could compare himself to the 'average' European or National (for selected data such as: number of children, equipment, income, taxes ...)?
- bringing many people together to attend a lecture by a key personality or to participate in a conference may be a worthwhile exercise, but both time-consuming and pretty expensive; could information highways provide a cost-effective solution, giving large numbers of people an opportunity to exchange experience and improve their skills?

Such practical applications are obviously considered by Eurostat in relation to priority themes, such as the European Monetary Union (Ref 5), education (1996 has been declared the European Year of Lifelong Learning (Ref 6)) and Euro-Mediterranean cooperation (Ref 7).

The Fourth Research and Development Framework Programme (Ref 8) has given Eurostat the opportunity to launch several research activities in this direction. Their general purpose is to investigate leading-edge technologies and to open ways for their future application to the field of statistical information, while staying close to the real needs of statisticians and statistics users. Prospective studies and practical considerations are being combined while carrying out this research, in order to:

- identify emerging technologies of potential interest to Eurostat and the European Statistical System precisely;
- select statistical fields likely to benefit from these new methods;
- define the methodology with which to assess the value of these new possibilities and their acceptance by users;
- create prototypes applying these new possibilities to selected statistical areas in order to test them on a representative sample of users;
- draw up concrete proposals on the exploitation of the results and define new directions for subsequent action.

Contribution to standardisation activities, as appropriate, and publication of results are considered to be important objectives for these projects so that European companies really can benefit from these research activities.

## Multimedia and new information technologies (Refs 9,10)

The merging of computing and communication is a key trend in information technology and has great potential. The general objective of Eurostat is to review leading-edge technologies and to evaluate how, in the medium term, they could help further improve the statistical information service provided to the European Union.

For instance, users might well soon be able to access information whenever they need it without any effort: properly equipped, they would invoke and instruct intelligent agents to monitor their own choice of statistics and make contact when specified conditions are met. They would then receive a limited volume of fresh information, combine it with large time series available locally and process the whole set with local, advanced multimedia systems.

**Figure 3:** Example of slow frame rate video transmitted over the GSM digital cellular telephone network (Ref 9).

**Figure 4:** Example of animated map: here, the inflation rate — successive periods can be seen in turn while captions and actual data are shown interactively by pointing and clicking (Ref 9).

The following possibilities are being assessed from the point of view of statistical data:

- performance of personal data assistants (PDAs) and communicators (with cellular modems) to access statistical information;
- usability of intelligent agents (knowbots) to retrieve relevant statistical information automatically;
- impact of higher bandwidth networks (e.g. ATM) on the dissemination of statistics-related information;
- possible synergy between networks and local storage media (hybrid CD-ROMs);
- feasibility of decentralized multimedia interfaces for interrogation and visualisation;
- applicability of remote programming and real-time interactivity with multimedia applications on the Web (e.g. ActiveX, Java or Shockwave);
- applicability of virtual reality (VRML) to improve access to statistical information;
- pilot applications of virtual conferences on the Internet;
- pilot applications of real-time video-conferencing on the Internet;
- pilot applications of real-time audio or video broadcasting on the Internet.

## Computer graphics and visualisation (Refs 11,12,13)

Computer graphics are already extensively used in other sciences (mathematics, physics ...) to represent realities that cannot directly be observed. Statisticians are however confronted with similar problems: could new computer graphics and image-synthesis technologies be applied to this field as well? The challenge here is to represent simultaneously as much data as possible, as clearly as possible, in order to increase information and to make it more understandable.

A flat image has two dimensions; the third dimension is traditionally represented by projection; computers can add a fourth dimension (time) by means of movement. However, is it possible — and if so, how — to go further in order to represent a large mass of correlated information better? Can new methods of data representation, whether static (typically, printed on paper) or dynamic and interactive (typically, displayed on a computer screen) enhance the user's understanding of statistics by:

- really introducing the third dimension, by the synthesis of stereoscopic images or holograms?
- really introducing the fourth dimension (time) by animation?
- using the three components of colour (RGB or HLS) to visualise three extra dimensions?
- transforming the original data, using advanced mathematics, before visualising it?
- using interactivity and virtual reality techniques, to go one step further?

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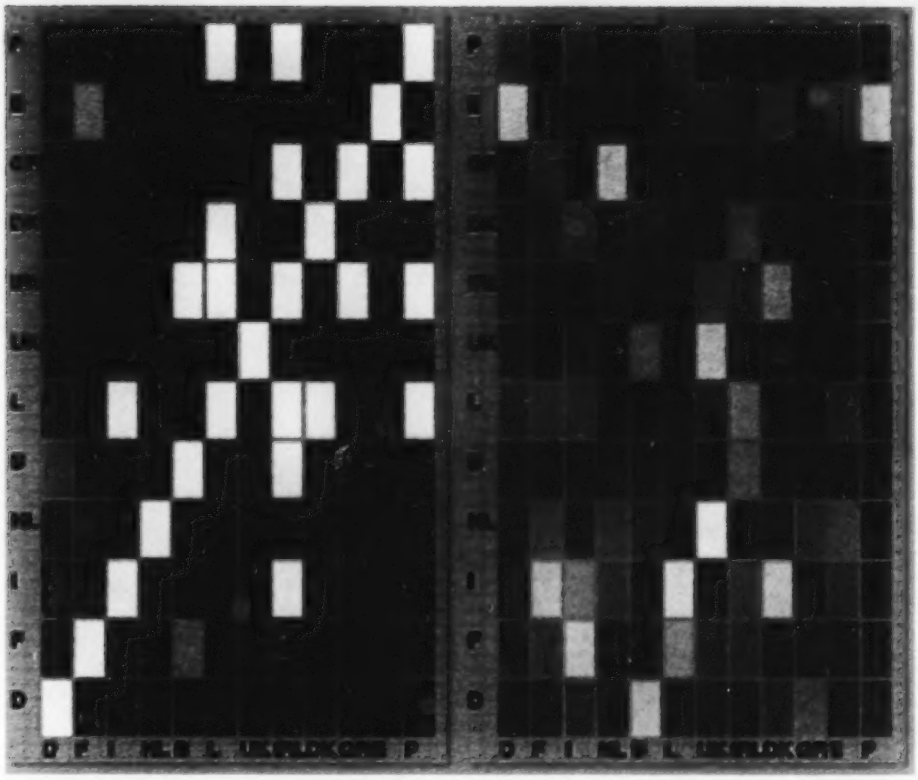

**Figure 5:** Colour Table Visualizer (Ref 12), applied to international traffic (1993) by road, rail and inland waterways.

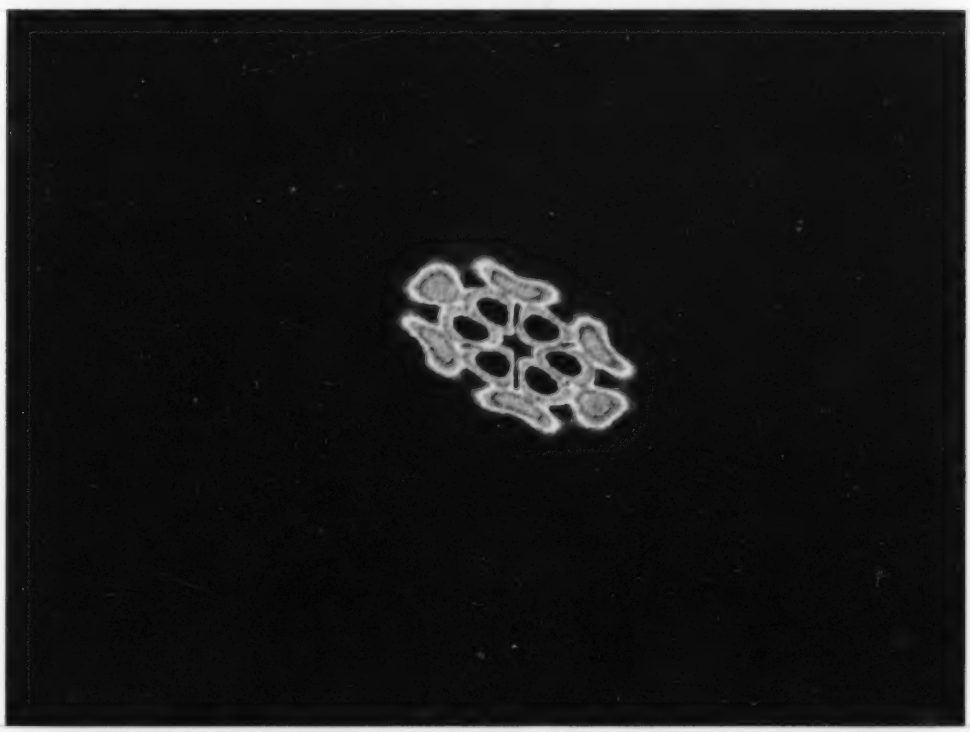

**Figure 6:** Bi-spectrum of the quantity of sports goods manufactured in Germany over the period January 1978–November 1995 (Ref 14).



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The following possibilities are being assessed from the point of view of statistical data:

- possibilities to represent graphically as much data as possible, simultaneously and as clearly as possible, in order to make information more understandable to the user;
- possibilities to represent graphically as much data as possible, simultaneously and as clearly as possible, in order to increase information by letting unsuspected correlation appear;
- suitability and implications of applying mathematical transforms, such as parallel coordinates, to data prior to their graphical visualisation;
- applicability of advanced techniques, such as stereoscopic images, holograms, interactivity and virtual reality ...

## Image and signal processing (Refs 13,14)

Ideally, multi-dimensional data should be presented so that all of the important information is accessible quickly. Over the last decade there have been significant developments in the fields of signal processing, image processing and video compression. This progress has resulted in a number of powerful techniques for the manipulation of multi-dimensional data. In addition, a number of powerful nonlinear data compression techniques have recently been developed for such data in the field of neural computing. By retaining only the most important aspects of the original data (the 'real' information) they might enhance intelligibility of complex data sets. However, to be efficient they generally exploit some *a priori* knowledge of the data structure.

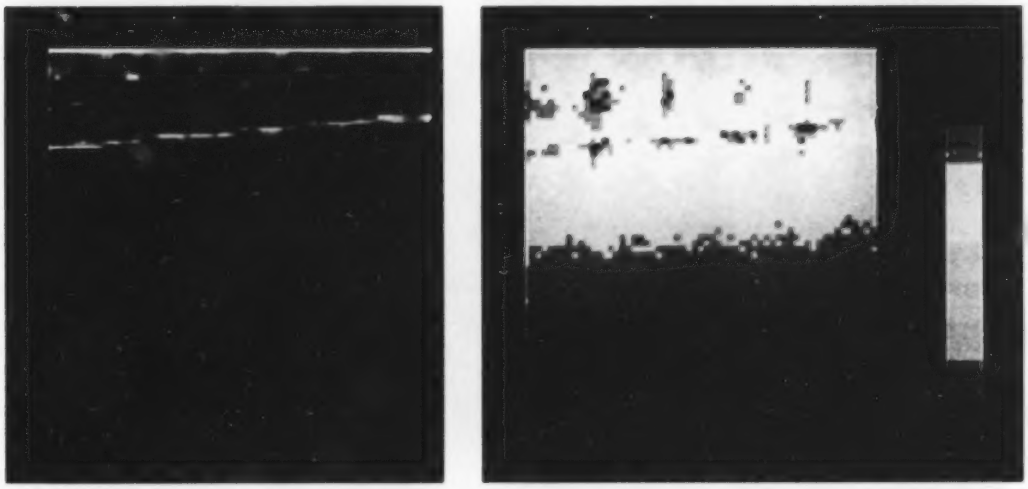

**Figure 7:** Application of horizontal edge detector (left) and pseudo-colouring (right) to heart attack mortality data (Ref 14).

The overall objective of this work is to identify new methods of representing statistical data which are based on signal processing, image processing and data compression techniques, and to evaluate how effective these new techniques are when compared to established methodologies. It will in particular:

- consider evolving and established signal processing, image processing and data compression techniques which will ensure that a broad range of approaches are addressed;
- compare the usefulness of the new techniques with that of established methods and thus provide a clear and representative evaluation of the strengths and weaknesses of the new techniques.

These questions raise the issue of precisely defining what is information, although it closely depends on individual users' expectations. For instance, one statistician will be interested in time series to analyse their trend with a view to forecasting the future, while his colleague next door will on the contrary focus on trying to understand and explain their spiky components; the noise then becomes the relevant information.

Results of this research are not yet available at the time of writing this article (September 1996); they will in principle be published in a summary report detailing the methods tested, the results obtained and guidelines for the future. This publication is likely to be made available on the Internet, together with some prototypes, so that feedback can be obtained from potential users. Results will also be presented at conferences like this one, when available.

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## Crystal-gazing

Crystal-gazing is a dangerous activity, especially in the field of new information technologies where progress is so fast. Reviewing predictions that concluded presentations at the 1st Online Information Conference, some 20 years ago, would undoubtedly be great fun.

I shall run the risk, nevertheless. What will be the trend for the next few years? A brave, new world is coming, where all problems will have been solved:

- images, whether still or animated, will become increasingly important: bandwidth limitations will indeed gradually be overcome;
- users will interact physically with statistical data: more and more powerful computers, associated to more and more sophisticated visual display units, will give access to virtual reality techniques;
- relevant information will be delivered automatically to users: you will no longer have to spend hours searching for data you desperately need; robots will learn what you are looking for and find it for you;
- you will always have access to the right information: your communicating personal data assistant, in your pocket, will take care of that.

But please allow me not to rate the probability that all this will occur ...

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